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Impact of animal saliva on the performance of rapid antigen tests for detection of SARS-CoV-2 (wildtype and variants B.1.1.7 and B.1.351)

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ABSTRACT

SARS-CoV-2 infects several animal species and SARS-CoV-2 variants of concern (VOCs) may even show (as in humans) enhanced inter- and intra-species transmission rates. We correlated sensitivity data of SARS-CoV-2 rapid antigen tests (RATs) to viral RNA genome equivalents analyzed by real-time reverse transcriptase-polymerase chain reaction (RT-PCR). Further, we checked their suitability for testing animals by assessing saliva and VOC effects. Viral loads up to 2 logs (RNA copy number) under the hypothetical SARS-CoV-2 infectivity threshold were detected by most analyzed RATs. However, while saliva from various animal species showed generally no adverse effects on the RATs' analytical sensitivities, the detection of VOCs B.1.1.7 and B.1.351 was in some RATs inferior to non-VOC viruses.

1. Introduction

Seven different coronaviruses are currently known to infect humans and all of them originate from animals (Su et al., 2016). In late 2019 a betacoronavirus of unknown origin, designated SARS-CoV-2 was identified and caused a worldwide pandemic. Apart from humans, SARS-CoV-2 can infect farmed animals, hamsters, minks, ferrets, raccoons, cats and dogs (Abdel-Moneim and Abdelwhab, 2020). Infections of lions, tigers, pumas, snow leopards, cynomolgus macaques, rhesus macaques, treeshrew, gorilla and others were also frequently reported (OIE, 2021). Clinical signs in animals are usually mild, but infections can also be fatal (de Morais et al., 2020; Ferasin et al., 2021). Several SARS-CoV-2 variants of concern (VOCs) are circulating worldwide and may even be more transmissible to and pathogenic for domestic animals than the original strain (Ferasin et al., 2021). There is also a possibility that such infected animals can more easily spill the virus back to humans. To date, rapid antigen tests (RATs) receive much attention as they provide on-site results without the need for elaborate instrumentation and/or expertise (Igloi et al., 2020). RATs are therefore part of most national testing strategies for humans worldwide. Hence, the question arose whether such assays would also be suitable as point-of-care diagnostics for SARS-CoV-2 in animals and, if so, whether the currently circulating VOCs are detected by them just as well. A broad analytical sensitivity study of 122 RATs for use in humans has shown recently that the majority of the assays are detecting SARS-CoV-2 viruses equivalent to about 10^5 genome copies (Scheiblauer et al., 2021). Another study on 5 commercial assays proved their suitability for detecting VOCs (B.1.1.7 and B.1.351) in principle but also revealed differences in analytical sensitivities for the variants (Jungnick et al., 2021). In the aforementioned test, VOCs were better detected than the original SARS-CoV-2 strains. VOCs are primarily defined by differences in spike protein, even though mutations in other viral proteins also exist. Therefore, it is not surprising that variable recognition by RATs, most of which use the nucleoprotein as a target, is observed between VOCs and common SARS-CoV-2 strains. In the described study here, we used saliva samples spiked with cell culture grown virus to show that RATs are also suitable tool for detecting animals shedding SARS-CoV-2. However, as it turned out limits of detection for VOCs can also be substantially lower, calling for detailed assay validations prior to their use.

2. Methods

2.1. Viruses and cells

Vero E6 cells (ATCC CCL-81) were grown and maintained in Eagle's minimal essential medium (EMEM; Lonza) with 8% foetal bovine serum

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